

Claims (for U. S. application)

1. An image processing method for correcting pixel values of each pixel constituting color image data by shifting, in a coordinate system,
5 a mathematical correction function defining correction values for input values, the method comprising the computer-implemented steps of:
 - (1) determining a maximum value and a minimum value among correction values (b, g, r) of respective color components obtained for each pixel by using said correction function and then calculating differences (Δb ,
10 Δg , Δr) between the respective correction values of the respective color components and said minimum value and calculating also a difference (DR) between said maximum value and said minimum value;
 - (2) dividing said calculated differences (Δb , Δg , Δr) between the respective correction values of the respective color components and said
15 minimum value by said calculated difference (DR) between said maximum value and said minimum value, thereby to obtain color ratios (Cb, Cg, Cr) for the respective color components;
 - (3) judging, as an inappropriate pixel, any pixel having a correction value overflowing from a predetermined maximum output gradation value and setting said overflowing correction value to said predetermined maximum output gradation value and judging also, as an inappropriate pixel, any pixel having a correction value underflowing from a predetermined minimum output gradation value and setting said underflowing correction value to said predetermined minimum output
20 gradation value; and
 - (4) effecting color balance adjustment so as to cause the correction values of said inappropriate pixel to agree with said respective color ratio thereof.

30 2. The image processing method according to claim 1,

wherein at the color balance adjusting step, if the correction value of at least one color component overflows from the maximum output gradation value, sums of said minimum value and respective product values obtained by multiplying a differences between the maximum output gradation value and the minimum value by the color ratios are used as the respective final pixel values.

3. The image processing method according to claim 1,
wherein at said color balance adjusting step, if the correction value of at
least one color component underflows from the minimum output gradation
value, the product value obtained by multiplying the maximum value by its
color ratio is used as its final pixel value.

4. An image processing apparatus for correcting pixel values
of each pixel constituting color image data by shifting, in a coordinate
system, a mathematical correction function defining correction values for
respective input values, the apparatus including a color balance adjustment
section for adjusting color balance of the corrected image data;

wherein the color balance adjustment section includes a
calculating section, a judging section and a gradation value determining
section;

said calculating section is operable to determine a maximum value
and a minimum value among correction values (b, g, r) of respective color
components obtained for each pixel by using said correction function and
then to calculate difference (Δb , Δg , Δr) between the respective
correction values of the respective color components and said minimum
value and calculate also a difference (DR) between said maximum value
and said minimum value;

said calculating section is further operable to divide said calculated
differences (Δb , Δg , Δr) between the correction values of the respective

color components and said minimum value by said calculated difference (DR) between said maximum value and said minimum value, thereby to obtain color ratios (Cb, Cg, Cr) for the respective color components;

5 said judging section is operable to judge, as an inappropriate pixel, any pixel having a correction value overflowing from a predetermined maximum output gradation value and set said overflowing correction value to said predetermined maximum output gradation value and to judge also, as an inappropriate pixel, any pixel having a correction value underflowing from a predetermined minimum output gradation value and set this
10 underflowing correction value to said predetermined minimum output gradation value; and

 said gradation value determining section effects color balance adjustment so as to cause the correction values of said inappropriate pixel to agree with said respective color ratio thereof.

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5. A computer-readable medium having stored thereon computer-executable instructions which when executed perform an image processing method, the method comprising the steps of:

20 (1) determining a maximum value and a minimum value among correction values (b, g, r) of respective color components obtained for each pixel by using said correction function and then calculating differences (Δb , Δg , Δr) between the respective correction values of the respective color components and said minimum value and calculating also a difference (DR) between said maximum value and said minimum value;

25 (2) dividing said calculated differences (Δb , Δg , Δr) between the respective correction values of the respective color components and said minimum value by said calculated difference (DR) between said maximum value and said minimum value, thereby to obtain color ratios (Cb, Cg, Cr) for the respective color components;

30 (3) judging, as an inappropriate pixel, any pixel having a

correction value overflowing from a predetermined maximum output gradation value and setting said overflowing correction value to said predetermined maximum output gradation value and judging also, as an inappropriate pixel, any pixel having a correction value underflowing from a predetermined minimum output gradation value and setting said underflowing correction value to said predetermined minimum output gradation value; and

(4) effecting color balance adjustment so as to cause the correction values of said inappropriate pixel to agree with said respective color ratio thereof.

6. An image processing apparatus for outputting image data consisting of a plurality of image data described in the RGB color system in a predetermined gradation range, the apparatus comprising:

15 a conversion section for converting the image data described in the RGB color system into a different color system for image quality adjustment;

20 an image quality adjustment section for effecting image quality adjustment on the image data converted into the different color system for image quality adjustment;

a reverse conversion section for reverse converting the image quality adjusted image data back into the RGB color system;

25 a color balance adjustment section; and a judging section for judging whether pixel values of each pixel constituting the reverse-converted image data are confined within said predetermined gradation range or not;

wherein for each pixel judged as being out of said predetermined gradation range by said judging section, said color balance adjustment section is operable to effect a predetermined calculation on pixel values of the respective color components included in that pixel thereby to cause the

pixel values thereof to be confined within said predetermined gradation range and said color balance adjustment section is further operable to adjust said pixel values of said pixel in such a manner as to fixedly maintain a ratio among the pixel values of the respective color components
5 based on the minimum value among said pixel values.

7. The image processing apparatus according to claim 6, wherein the color balance adjustment section is operable to fixedly maintain also an average value of the pixel value of each color component
10 contained in the pixel prior to the adjustment.

8. The image processing apparatus according to claim 6, wherein the color balance adjustment section is constructed such that when the judging section judges the maximum pixel value contained in the pixel
15 as overflowing from the predetermined gradation range, this maximum pixel value is caused to agree with the maximum value of the predetermined gradation range.

9. The image processing apparatus according to claim 6,
20 wherein the color balance adjustment section is constructed such that when the judging section judges the minimum pixel value contained in the pixel as underflowing from the predetermined gradation range, this minimum pixel value is caused to agree with the minimum value of the predetermined gradation range.
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10. The image processing apparatus according to claim 6, wherein the color balance adjustment section is operable to maintain the ratio and/or the average value of the pixel value of the pixel for adjustment.